

WHAT IS CLAIMED IS:

- 1.) A nozzle heater-cooler assembly for heating and cooling a nozzle comprising:
 - a) a hollow cylindrically shaped cartridge that contains an electrical element that contacts flat against the bottom surface of a housing;
 - b) a spring that biases said cylindrically shaped cartridge that contains an electrical element housing to an elevation that has a lower altitude than a nozzle with a groove elevation measured from the base of said nozzle hub forcing deflection of a spring that surrounds the cartridge to enable a change in altitude of said electrical element;
 - c) a second larger diameter cylindrically shaped body that said cylindrically shaped cartridge and said spring are fit surrounds the cartridge and spring;
 - d) a central opening means for allowing said heater-cooler assembly to slide on body of said nozzle and moveable from an unlocked position with main slide retracted from said nozzle with a groove to a locked position with said main slide extending into said nozzle with a groove;
 - e) an electrical path through metallic rods and springs to enable conductors to fit in a small space and allow movement by translation of the electrical path along one axis;
 - f) a series of dissimilar metal rods with a common heat conduction pad that enables electrical connection of all said dissimilar metal rods;
 - g) a convective cooler design for said nozzle that simultaneously directs pressurized gas along each face of a hexagonal shaped hub;
 - h) a resistive element design composed of two elements on parallel planes, electrically connected in a series circuit.
- 2.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1, wherein said change in altitude of electrical element divided into the perimeter of the heated space exceeds one.

- 1 3.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1,
2 wherein said second larger diameter cylindrically shaped body that cartridge and
3 spring are fit is about 50mm in diameter and 25 to 40 mm in height.
- 4 4.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1,
5 wherein said hollow cylindrically shaped cartridge that contains an electrical
6 element that contacts flat against the bottom surface of a housing is between 8
7 mm to 20 mm in diameter.
- 8 5.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1,
9 wherein said resistive element design composed of two elements on parallel
10 planes, electrically connected in a series circuit are helix shaped windings of high
11 resistance metallic conductor with a resistance somewhere between 50 and 250
12 ohms.
- 13 6.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1,
14 wherein said central opening means for allowing heater-cooler assembly to slide
15 on body of said nozzle and moveable from an unlocked position with said main
16 slide retracted from said nozzle groove to a locked position with said main slide
17 extending into groove on said nozzle is a flat guillotine mounted slide
18 perpendicular to the axis of the cylindrical body occupying a slot through the part
19 preventing egress of said cylindrically shaped cartridge and spring that biases
20 said cylindrically shaped cartridge.
- 21 7.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1,
22 wherein said central opening means for allowing said heater-cooler to slide on
23 body of said nozzle and moveable from an unlocked position with said main slide
24 retracted from said nozzle groove to a locked position with said main slide
25 extending into groove on said nozzle hub is locked by means of an outwardly
26 extending retaining member.
- 27
28
29

- 1 8.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1,
2 wherein said hollow cylindrically shaped cartridge that contains an electrical
3 heating element which is in contact flat against the bottom surface of a thermally
4 conductive, electrically insulating housing resting on an interior lip extending
5 around the inside perimeter of said cylindrically shaped cartridge, conducts heat
6 into the enclosed space containing and surrounding said nozzle.
- 7 9.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1,
8 wherein said second larger diameter cylindrically shaped body that said
9 cylindrically shaped cartridge and spring are fit utilizes o-rings to seal the
10 interface between said cylindrically shaped cartridge and said larger diameter
11 cylindrically shaped body from gas pressure loss.
- 12 10.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1,
13 wherein said resistive element design composed of two elements on parallel
14 planes, electrically connected in series are out of phase 180° in comparison of
15 said lower element winding start to said upper element winding start around a
16 concentric cylinder.
- 17 11.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1,
18 wherein said series of dissimilar metal rods that contact a common heat
19 conduction pad which enables electrical connection of all dissimilar rods to form
20 a series circuit pair wise, any two dissimilar rods will produce discrete
21 thermocouple types.
- 22 12.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1,
23 wherein said, convective cooler design for a nozzle that simultaneously directs
24 pressurized gas along each face of a hexagonal shaped hub uses a diffuser to
25 direct and distribute cooling gas to each face of said hexagonally shaped nozzle
26 base.
- 27 13.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1,
28 wherein said central opening means for allowing said heater-cooler assembly to
29 slide on body of said nozzle and moveable from an unlocked position with main
30 slide retracted from said nozzle with a groove to a locked position with said main
31 slide extending into said nozzle with a groove and has an integral abutment and

said lower body includes an abutment that are coincident when lock is in the normally closed position and are closely spaced when locked to said nozzle body.

- 14.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1, wherein said central opening means for allowing said heater-cooler to slide on body of said nozzle and moveable from an unlocked position with said main slide retracted from said nozzle groove to a locked position with said main slide extending into groove on said nozzle and sealed around the nozzle body outside diameter using a seal clamped to said heater-cooler upper body to prevent contaminates from entering into the bore.
- 15.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1, wherein said electrical path through said metallic rods and springs to enable conductors to fit in a small space and allow movement by translation of the electrical path along one axis uses pins from the integral connector as cantilever springs that are in intimate contact with said rods in each groove to enable construction of sliding discrete connections.
- 16.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1, wherein said resistive element design composed of two elements on parallel planes, about 0.1 mm to 2 mm but more preferably 0.1 mm to 1 mm apart.
- 17.) The nozzle heater-cooler assembly for heating and cooling a nozzle of Claim 1, wherein said central opening means for allowing said heater-cooler to slide on body of said nozzle hub and moveable from an unlocked position with said main slide retracted from said nozzle hub groove to a locked position with said main slide extending into groove on said nozzle hub with enough force to resist any strong movement but allow rotation so as not to exert torque on said nozzle hub.
- 18.) A nozzle hub for connection and support of said nozzle heater-cooler has a groove that extends concentrically around the hub body circumference, which can be continuous or intermittent in 360° of rotation at an altitude that exceeds the depth of said element housing installed in the spring biased cartridge.

- 1 19.) A nozzle heater-cooler for heating and cooling said nozzle comprising:
- 2 a. an input port for cooling gas flow into the heater-cooler assembly;
- 3 b. an integral electrical connector is molded into the lower body of the assembly
- 4 for electrical input and temperature data output;
- 5 c. connection logistics for the heater-cooler assembly require said larger
- 6 diameter cylindrically shaped body to integrate triangular protrusions
- 7 opposite said main slide.
- 8 20.) The nozzle heater-cooler for heating and cooling said nozzle of Claim 19,
- 9 connection logistics for the heater-cooler assembly require said larger diameter
- 10 cylindrically shaped body to integrate triangular protrusions opposite said main
- 11 slide, radii across the rear legs of the triangular protrusions are large enough to fit
- 12 index finger and forefinger to enable use of thumb for actuation of said main
- 13 slide.
- 14
- 15
- 16
- 17
- 18
- 19
- 20
- 21
- 22
- 23
- 24
- 25
- 26
- 27
- 28
- 29
- 30
- 31